

breeding season and thus cannot be entirely connected to reproductive and agonistic interactions which in both nocturnal and diurnal mammals and birds often peak at activity onset (for review see DAAN and ASCHOFF 1982). Although hares, once they are regularly active diurnally, rapidly extend the duration of daylight activity, none the less the inhibitory factor appears to be still operating to the extent that, in this study area, the duration of activity remains shorter than during the totally nocturnal regime. There are indications of a relatively sudden withdrawal from daylight activity at the end of the breeding season in August.

Of related species, studies using automatic activity recording of mountain hares (*Lepus timidus*) in Sweden by CEDERLUND and LEMNELL (1980) and LEMNELL and LINDLOF (1981) showed a close relationship between sunset and onset of activity and sunrise and cessation of activity in winter. Daylight activity gradually increased up to 50% in summer when the nights were very short. The study of MECH et al. (1966) on five radio-collared snowshoe hares (*Lepus americanus*) in Minnesota, USA, also showed that seasonal changes from January to May in both onset and cessation of activity followed the trend of changing sunrise-sunset times, but with the difference that

contraction of the activity period continued into May when it amounted to less than nine hours. I propose that the proximate cause of cyclicity in the activity period of brown hares is an aversion to daylight activity. It seems that this may be shared by a number of other leporid species.

The emergence of the brown hare from darkness on to the daylight arena in March, as demonstrated in this study, adds further clarification to the explanation of the "mad March hare" of literature (CARROL 1865) given by HOLLEY and GREENWOOD (1984).

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## Zusammenfassung

### Die tägliche Aktivitätsperiode des Europäischen Feldhasen (*Lepus europaeus*)

Um die Veränderung der Länge der täglichen Aktivitätsperiode im Laufe eines Jahres für Feldhasen zu bestimmen, wurde die Nutzung der Sassen auf einem 65 ha großen Gebiet in Südwestengland aufgezeichnet. Dabei wurde das Aufsuchen ( $n = 241$ ) und das Verlassen der Sasse ( $n = 573$ ) protokolliert. Im Dezember (Nachtlänge: 16 h) waren die Hasen ausschließlich nachtaktiv. Die Intervalle zwischen dem Aufsuchen einer Sasse und dem Sonnenaufgang waren länger und inkonsistenter als jene zwischen dem Verlassen der Sasse und dem Sonnenuntergang. Im Juni (Nachtlänge: 7,4 h) reichte die Aktivitätsperiode für insgesamt 6 h in den Tag hinein: Sie endete erst nach Sonnenaufgang und begann bereits vor Sonnenuntergang. Die Länge der Aktivitätsperiode verkürzte sich entsprechend der Nachtlänge von 14,5 h im Dezember auf 12 h in der dritten Märzwoche. Daraufhin stieg die Aktivitätslänge auf 13,5 h im Spätsommer, um im Herbst wiederum zu sinken. Diese Ergebnisse weisen daraufhin, dass eine proximate Ursache für den circannualen Rhythmus bei Feldhasen eine Vermeidung von Aktivität bei Tageslicht ist.

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### Author's address:

Dr. A. J. F. HOLLEY, Ferndale House, Wick Lane, Brent Knoll, Highbridge, Somerset. TA9 4BU. U.K.



## Short communication

# Home range size, movements, and habitat utilization of three male European wildcats (*Felis silvestris* Schreber, 1777) in Saarland and Rheinland-Pfalz (Germany)

By H. U. WITTMER

Institut für Biogeographie, Universität des Saarlandes, Saarbrücken, Germany

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Although several radio-telemetry studies of European wildcats have been conducted (e. g. CORBETT 1979; STAHL et al. 1988; LIBERREK 1999), systematic investigations on European wildcats are lacking in Germany. Due to a population size of approximately 1000 individuals (F. RAIMER pers. comm.) and the connection to wildcat populations in neighbouring France and Luxembourg, the population in Rheinland-Pfalz is of great importance for the conservation of wildcats in central and western Europe. Therefore, a radio-telemetry study was conducted in Saarland and adjacent parts of Rheinland-Pfalz, to assess home range size, movements and habitat utilization of European wildcats in this region.

The study area encompassed approximately 130 km<sup>2</sup> in northern Saarland and southern Rheinland-Pfalz, southwest Germany (6°55' E, 49°36' N). Elevation in the area ranges from 250 to 650 m. Precipitation is greatest at high elevations and ranges annually from 700 to 1000 mm and temperatures vary from –16.5 °C to over +30.0 °C (FISCHER 1989). A mean snow depth of 10 cm is recorded for 10 to 80 days. Approximately 39% of the study area was forested. The dominate native tree was red beech (*Fagus sylvatica*), but spruce (*Picea*

*abies*) and Douglas fir (*Pseudotsuga menziesii*) were commonly planted. At lower elevations agriculture was common and forest climax consisted of submontane beech-oak-forests (*Quercus petraea*). Current agricultural practices result in many fallow fields and meadows.

Over the duration of the study, 3 male wildcats were caught in box traps, sedated with a Ketamin/Xylazin-mixture (HATLAPA and WIESNER 1982), weighed, measured, and radiocollared (50 g; K. Wagener Cologne, Germany) (Tab. 1). Approximate age was estimated based on tooth succession and condition.

Wildcats were primarily located continuously during their main active period at night resulting in successful locations approximately once every 50 minutes. Accuracy of radio locations was evaluated under different habitat conditions, consistent with literature standards (WHITE and GARROTT 1990) and allowed to evaluate a habitat-specific telemetry error of 100 m. For home range analysis, locations were filtered for 2 hour intervals to equally distribute the data. Adaptive Kernel (AK) estimates (WORTON 1989) of annual and seasonal home ranges were estimated using the program Ranges V (KENWARD 1995). In addi-

tion, minimum convex polygons (MCP) (MOHR 1947) were measured for comparison with previous research.

The area enclosed in the 95% AK contour was defined as the home range of an individual to exclude outliers. Core areas were defined as the area within the 50% contour. Seasonal delineations considered mating behaviour (PIECOCKI 1990) and prey availability (SLÁDEK 1973) and included: winter mating season (January–March), spring (April–June), summer (July–September), and autumn (October–December). Over the duration of this study, M1 was monitored for 249 days, M2 for 49 days, and M3 for 266 days resulting in a total of 1276 relocations with 77% of the locations being recorded between 18.00 h and 07.00 h.

Minimum nightly movements were calculated by summing the distances between relocations of nights where cats were followed for  $\geq 5$  hours and both daily resting sites were recorded. The average observation time per night was 9.35 hours. ( $SD = 3.02$ ) resulting in an average of 11 ( $SD = 4$ ) successful locations per night.

Locations were imported into the Geographic Information System (GIS) Map-Grafix (ComGrafix USA). Habitat use was determined using a circular buffer with a 100 m radius around the locations filtered for a 1 hour interval. Within this 3.14 ha buffer the extent of each habitat was recorded. When analyzing for seasonal habitat use, areas for each habitat category included in all locations were summed to equal the probability that a location was in a specific habitat category. Analysis of habitat utilization was restricted to M1 and M2 as digitized maps were unavailable for M3. Selection of habitat was assessed by comparing availability and use of habitat types within the total range (100% AK) of an individual following the method described by NEU et al. (1974). An  $\alpha = 0.05$  was used to determine significance for tests of the null hypotheses.

**Home range:** The largest seasonal home range of 2515 ha was observed in winter 1996 for M2 (Tab. 1). Both M1 and M3 had their largest seasonal home ranges during

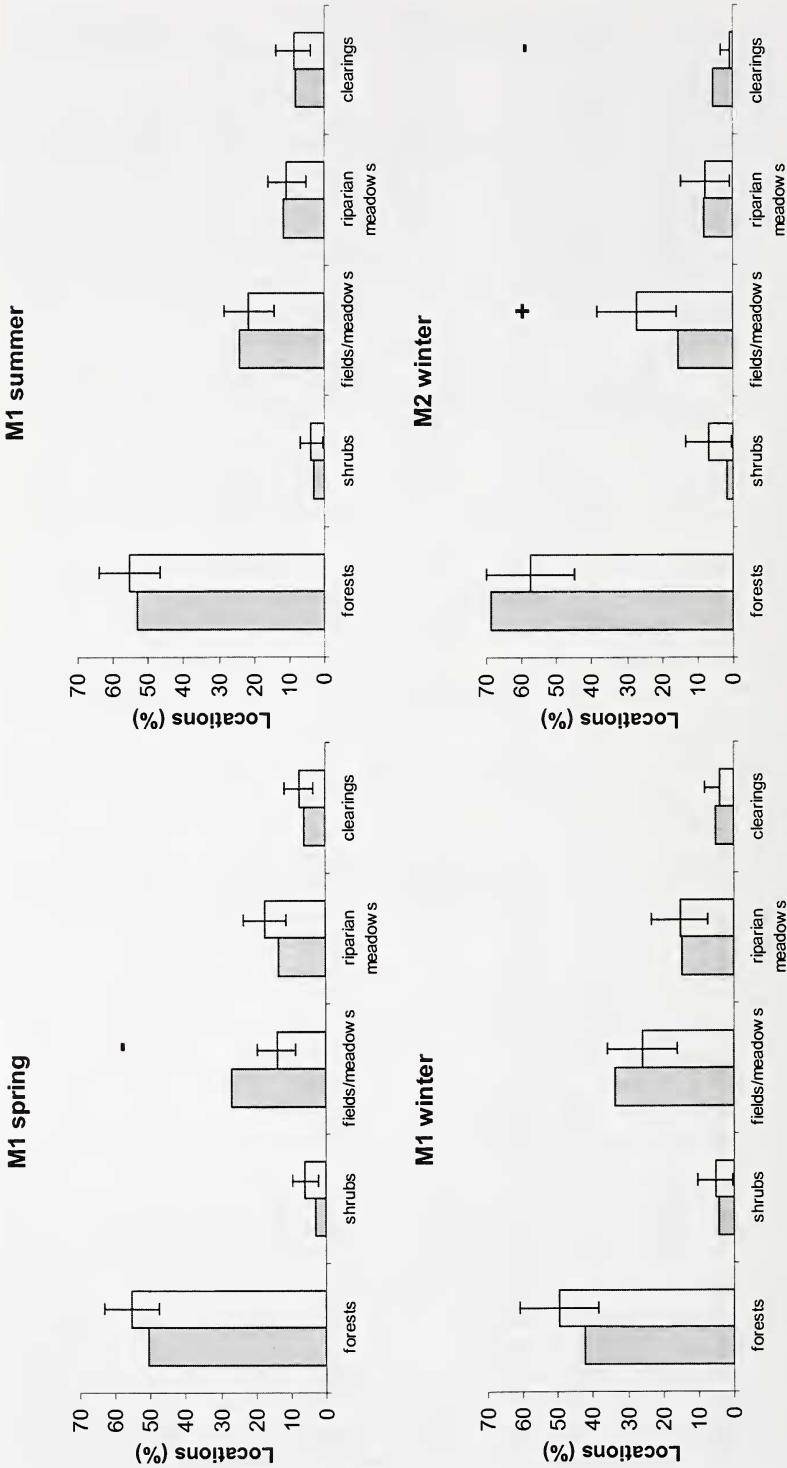
spring. Seasonal home ranges during winter and spring were significantly larger than during summer and autumn (one tailed t-test,  $df = 6$ ,  $p = 0.025$ ). Accounting for the total number of relocations, annual home ranges were estimated to be 1407 ha for M1 and 1916 ha for M3, averaging 1662 ha. Core areas ranged from 92 to 460 ha. Spatial overlap between M1 and M2 during January and February 1996 was 224 ha. Therefore M1 shared 29% and M2 approximately 9% of its range. Core areas were used exclusively.

**Nightly movements:** The seasonal average of distances travelled per night ranged from 2.8 km during summer to 11.3 km during winter (Tab. 1). Over a period of 14 hours, the longest observed nightly movement was 13.3 km recorded for M2 in February 1996. Nightly movements during winter/spring averaged 5.5 km ( $SD = 2.6$  km) and were significantly longer than movements during summer/autumn averaging 3.0 km ( $SD = 1.2$  km) (one tailed t-test,  $df = 70$ ,  $p < 0.001$ ).

**Habitat use and selection:** More than 1 habitat category was found within the 100 m accuracy buffer around 74% of the locations of M1 and 65% of the locations of M2. Of these 85 and 79% included forest edge for M1 and M2 respectively. Of the locations encompassing only 1 habitat category, 96% were in forests. For both cats, 3 habitat types (forests, fields/meadows, riparian meadows) accounted for 86 to 91% of the relocations. Forests were used most intensively throughout the study period ranging from 50 to 55% of the locations. Fields/Meadows were used by M1 more intensively during winter and summer, riparian meadows were used most often in spring. Percentages of forested areas included in seasonal total ranges varied between 40 and 66%.

Habitat use was significantly different from expected for M2 during winter, showing preference for fields/meadows and avoidance for clearings ( $\chi^2 = 30.41$ ,  $df = 4$ ,  $p < 0.001$ ) (Fig. 1). During the same period M1 used habitats proportionately to their occurrence ( $\chi^2 = 4.52$ ,  $df = 4$ ,  $p = 0.34$ ). M1





**Fig. 1.** Habitat selection M1 and M2; grey columns indicate availability within individual seasonal total range, white columns indicate habitat use, error bars indicate confidence intervals according NEU et al. (1974), ± = habitat use significantly different from expected.